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On the PRIMITIVE STATE *of the* GLOBE *and its* SUBSEQUENT CATASTROPHE. B*y* RICHARD KIRWAN, *Eſq; L.L.D. F.R.S. and M.R.I.A.*

Read Nov. 19th 1796.

IN the inveſtigation of paſt facts dependent on natural cauſes, certain laws of reaſoning ſhould inviolably be adhered to. The firſt is, that no effect ſhall be attributed to a cauſe whoſe *known* powers are inadequate to its production. The ſecond is, that no cauſe ſhould be adduced whoſe exiſtence is not proved either by actual experience or approved teſtimony Many natural phænomena have ariſen or do ariſe in times or places ſo diſtant, that well conditioned teſtimony concerning them cannot without manifeſt abſurdity be rejected. Thus the inhabitants of the Northern parts of Europe, who have never felt earthquakes nor ſeen volcanos, muſt nevertheleſs admit, from mere teſtimony, that the firſt *have* been, and that the ſecond *do actually* exiſt.

THE third is, that no power ſhould be aſcribed to an alleged cauſe but thoſe that it is known by actual obſervation to poſſeſs in appropriated circumſtances.

To theſe laws I mean ſtrictly to conform in the ſubſequent inquiry, and on this conformity to reſt its merits. To them I ſhall appeal in examining the various ſyſtems I may have occaſion to mention.

To thoſe who may regard this inquiry as ſuperfluous, and conſider the actual ſtate of the globe as alone intitled to philoſophical attention, I ſhall beg leave to obſerve that its original ſtate is ſo ſtrictly connected with that which it at preſent exhibits, that the latter cannot be properly underſtood without a retroſpect to the former, as will amply be ſhewn in the ſequel. Moreover recent experience has ſhewn that the obſcurity in which the philoſophical knowledge of this ſtate has hitherto been involved, has proved too favourable to the ſtructure of various ſyſtems of atheiſm or infidelity, as theſe have been in their turn to turbulence and immorality, not to endeavour to diſpel it by all the lights which modern geological reſearches have ſtruck out. Thus it will be found that geology naturally ripens, or (to uſe a mineralogical expreſſion) *graduates* into religion, as this does into morality.

So numerous indeed and ſo luminous have been the more modern geological reſearches, and ſo obviouſly connected with the object we have now in view, that ſince the obſcuration or obliteration of the primitive traditions, ſtrange as it may appear, no period has occurred ſo favourable to the illuſtration of the original ſtate of the globe as the preſent, though ſo far removed from it. At no period has its ſurface been traverſed in ſo many different directions, or its ſhape and extent under its different modifications of earth and water been ſo nearly aſcertained, and the relative denſity of the whole ſo accurately determined, its ſolid conſtituent parts ſo exactly diſtinguiſhed, their mutual relation, both as to poſition and compoſition, ſo clearly traced, or purſued to ſuch conſiderable depths as within theſe laſt twenty-five years. Neither have the teſtimonies that relate to it been ever ſo critically examined and carefully weighed, nor conſequently ſo well underſtood, as within the latter half of this century.

THE introduction of teſtimony into reſearches merely philoſophical has been, I am well aware, objected to by many, but in the preſent caſe the objection evidently originates in inattention to its object. All philoſophical reſearches are grounded either on experiment or obſervation ſingly or jointly, and the conſequences clearly deducible from them. Where recourſe cannot be had to experiment, as in the preſent caſe, there obſervation ſingly muſt be reſorted to, but as objects even of obſervation are not of daily occurrence, and many of them muſt have exiſted at diſtant intervals of time and place, recourſe muſt be had to its *records* and conſequently to teſtimony. Aſtronomy furniſhes us with a caſe in point. This is a ſcience purely philoſophical, yet aſtronomers have never heſitated to admit the obſervations of an Hipparchus

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or a Ptolemy. In effect paſt geological facts being of an hiſtorical nature, all attempts to deduce a complete knowledge of them merely from their ſtill ſubſiſting conſequences, to the excluſion of unexceptionable teſtimony, muſt be deemed as abſurd as that of deducing the hiſtory of ancient Rome ſolely from the medals or other monuments of antiquity it ſtill exhibits, or the ſcattered ruins of its empire, to the excluſion of a Livy, a Salluſt or a Tacitus. That great changes have taken place on the ſurface of the globe ſince the commencement of its exiſtence, changes that for ſome thouſand years have not been repeated, is allowed on all hands. What then ſhould render theſe facts and the circumſtances attending them unſuſceptible of teſtimony? not ſurely their improbability or diſcrepance with actual obſervation, ſince their reality is confeſſed by all; with reſpect to *ſome* of them I can think of no reaſon but one, and that indeed at the firſt bluſh ſufficiently plauſible, namely that their exiſtence preceded that of the human ſpecies; this certainly proves that the knowledge of the hiſtorian that relates them (ſuppoſing him to have any) was not as to ſuch facts obtained by human means. But if in a ſeries of facts diſcovered by an inveſtigation to which the witneſs was an utter ſtranger, an exact agreement with the relation of the hiſtorian be diſcerned, not barely as to the ſubſtance of the facts but even as to the order and ſucceſſion of their exiſtence, in ſuch caſe it muſt be acknowledged that the relation is *true*, let the knowledge of the hiſtorian have been obtained how it may. If its primary ſource cannot be human it muſt have been ſupernatural, and moſt aſſuredly worthy of credit even in ſuch inſtances as have not as yet been corroborated by obſervation, or perhaps are incapable of ſuch additional proof. Now ſuch an account of the primæval ſtate of the globe and of the principal cataſtrophes it anciently underwent, I am bold to ſay Moſes preſents to us, and I make no doubt of demonſtrating in the following Eſſays.

FIRST ESSAY

ON THE

PRIMÆVAL STATE OF THE GLOBE.

The firſt remarkable fact that preſents itſelf to our notice on conſidering the primitive ſtate of the globe is, that its ſuperficial parts, at leaſt to a certain depth, muſt have originally been in a ſoft or liquid ſtate. This fact is inferred from the ſhape it at preſent exhibits, which, as aſtronomers tell us, is that of a ſphœroid compreſſed at the poles, the polar diameter being found ſeveral miles ſhorter than the æquatorial; nor is it at the poles only that this compreſſion is obſervable, but in all the higher degrees of latitude, nearly in proportion to their proximity to the poles. This ſhape it evidently could not aſſume unleſs to a certain depth its ſuperficial parts were in a ſoft or liquid ſtate. Some *geological* obſervations alſo indicate that its component parts, even thoſe that are at preſent the moſt ſolid, were originally in a ſoft ſtate. Thus in the mountains of Quedliœ and Portfiœllet in Norway, which conſiſt of an argillaceous pudding ſtone, the ſiliceous pebbles it contains are obſerved to be compreſſed to the thickneſs of about $\frac{1}{4}$ of an inch in the lower parts of the mountains, but to increaſe in ſize and roundneſs in proportion as their ſituation is higher.—1. Bergm. Erde Beſch. 182. and in the *Vivarois* the loweſt ſtrata of primitive limeſtone have been found of the thickneſs of only $\frac{1}{10}$ of an inch, but in proportion to their heighth in the mountain their thickneſs increaſes, until at its ſummit it arrives to thirty or forty feet. 1. Soulavie, 178. Mr. Ferner made the ſame obſervation in England*, but it is needleſs to inſiſt further on this point, as it is now generally allowed.

With reſpect to the interior and more central parts, they having been hitherto inacceſſible, nothing can be determined from immediate obſervation, but we may collect with ſufficient certainty, and it is now generally acknowledged, that at the time of the creation and for many centuries after they contained immenſe empty caverns, and conſequently conſiſted of materials ſufficiently ſolid to reſiſt the preſſure of the enormous maſs of liquid ſubſtance placed over them.

The liquidity thus proved to exiſt in the more ſuperficial parts of the globe, comprehending even thoſe that are now moſt ſolid, muſt have proceeded either from igneous fuſion or ſolution in water. The hypotheſis of igneous fuſion wars with every notion which experiment has taught us to form either of fire or its fuel, or the properties and appearances of the various ſubſtances ſuppoſed to be ſubjected to it, as I have ſhewn at large in a former diſſertation contained in the Tranſactions of this Academy; the latter perfectly accords, and much more perfectly than I was then aware of, with all the properties and characters that all the ſolids now known exhibit, thoſe confeſſedly of volcanic origin ſolely excepted.

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* 1 Roz. 8vo. p. 64. and Gruber in Carniola. Phy. Arbeit. 2d Stuck. 3.

The difficult ſolubility in water of moſt of the ſolids which the globe at preſent exhibits, and the immenſe quantity of that fluid requiſite to effect their ſolution, forms the only difficulty that has hitherto embarraſſed geologiſts, though it has prevented ſcarce any of them from admitting that ſolution. Moſt of them have ſuppoſed that at that early period ſome menſtruum exiſted capable of effecting it. This difficulty however proceeds ſolely from inattention to the firſt demonſtrated fact, namely, that the globe at its origin, at leaſt to a certain depth, was a liquid maſs; therefore the ſolids that at preſent compoſe it were not originally in a ſolid ſtate, whoſe converſion into a ſtate of liquidity would certainly require more water than is known to exiſt, but were at the very commencement of their exiſtence in that ſtate of minute diviſion which aqueous ſolution requires, but which no known exiſting quantity of that fluid would be able to effect.

Now it is a well known chymical fact that leſs of any menſtruum is requiſite to keep a ſolid ſubſtance in ſolution, at leaſt for a ſhort time, than originally to diſſolve it.

YET if the quantity of aqueous fluid requiſite even to keep the maſs of ſolids in ſolution were too ſmall, as poſſibly it may have been, this would only haſten the *ſecond* general fact to which I now proceed, namely, the cryſtallization, precipitation and depoſition of theſe ſolids. But before I enter on this event it will be neceſſary to conſider more particularly the ſtate of this original chaotic fluid.

THE water which conſtituted this menſtruum being in a liquid ſtate muſt have been heated at leaſt to thirty-three degrees, and poſſibly much higher. Secondly, it contained the eight generic earths, all the metallic and ſemi-metallic ſubſtances now known, the various ſimple ſaline ſubſtances, and the whole tribe of inflammables, ſolid and liquid, which are of a ſimple nature, variouſly diſtributed, forming upon the whole a more complex menſtruum than any that has ſince exiſted, and conſequently endued with properties very different from any with which we have been ſince acquainted.

HENCE elementary fire or the principle of heat muſt have been coeval with the creation of matter, and the general properties of gravitation and elective attraction may be ſuppoſed of equal date.

THE proportion of the different materials contained in the chaotic fluid to each other may be ſuppoſed upon the whole nearly the ſame as that which they at preſent bear to each other, the ſiliceous earth being by far the moſt copious, next to that the ferruginous, then the argillaceous and calcareous, laſtly the magneſian, barytic, Scottiſh and Iargonic, in the order in which they are named, the metallic ſubſtances (except iron) moſt ſparingly; in particular parts however of this polygenous fluid a very different proportion muſt have obtained (as in ſome parts of the globe) ſome ſpecies of earth or metal, &c. have evermore been found more copious than in others. Some geologiſts, as Buffon, and of late Doctor Hutton, have excluded calcareous earth from the number of the primæval, aſſerting the maſſes of it we at preſent behold to proceed from ſhell fiſh. But in addition to the unfounded ſuppoſition, that ſhell fiſh or any animals poſſeſs the power of producing any ſimple earth, theſe philoſophers ſhould have conſidered that before the exiſtence of any fiſh the ſtony maſſes that incloſe the baſon of the ſea muſt have exiſted, and among theſe there is none in which calcareous earth is not found. Of this circumſtance indeed Buffon was ignorant, the analyſes that prove it being unknown to him. Doctor Hutton endeavours to evade this argument by ſuppoſing the world we now inhabit to have ariſen from the ruins and fragments of an anterior, and that of another ſtill prior, without pointing at any original. If we are thus to proceed *in infinitum* I ſhall not pretend to follow him, but if he ſtops anywhere, unleſs he alſo ſuppoſes his primitive globe abſolutely different from that which we inhabit, (and with ſuch I do not meddle) he will find the ſame argument equally to occur.

In a fluid conſtituted as that juſt mentioned, it is evident, from the laws of elective attraction, that the various ſolids diffuſed through it muſt ſoon have coaleſced in various proportions according to the laws of this attraction and the preſence or proximity of the ingredients, and thus have cryſtallized into different groups, which deſcended to and were depoſited on the inferior ſolid kernel of the globe. In thoſe tracts in which the ſiliceous, and next to it the argillaceous earth moſt abounded, (and ſuch tracts appear to have been by far the moſt extenſive) granite and gneiſs appear to have been firſt formed, and their formation may thus be explained: Both theſe rocks conſiſt of quartz, felſpar and mica, in a variable proportion, but the quartz and felſpar are generally the moſt copious. Theſe ſtones are themſelves compoſed of ſiliceous and argillaceous particles, and particularly the firſt, principally of ſiliceous, the two latter admitting alſo the argillaceous and a ſmall proportion of the calcareous, the magneſian and in ſome inſtances of the barytic. Now of theſe earths, *that* ſhould coaleſce firſt, which with an equally ſmall affinity to water was at the ſame time moſt plentifully contained in it, its particles being more within the reach of each other's attraction. Hence we may conclude that the quartz firſt cryſtallized, ſcarce ever indeed perfectly, from the diſturbance that muſt have occurred in ſuch an immenſe body of an heterogeneous fluid, nor perfectly pure by reaſon of its affinity to argil and calx. Next to this felſpar, containing a ſmaller proportion of ſilex and a larger of the other earths, proportions which, from their eaſy fuſibility, alſo appear to exhibit the *maximum* of attraction of theſe earths to each other when ſilex and argill prevail, muſt have cryſtallized next, and laſtly the mica, a ſtone in which the proportion of ſilex to argil is ſtill ſmaller. The portion of water diſengaged from theſe earths gradually aſcended and made room for new ſhoots, which attaining the foregoing before they were perfectly hardened adhered to them cloſely, and thus at laſt vaſt uniform blocks were formed; where the ſhoots had not attained a certain degree of hardneſs, or the ſofter ingredient, viz. the mica abounded, the gneiſs was formed; and where the proportions requiſite to form felſpar were deficient, the other granitic ingredients being preſent, ſhiſtoſe mica was formed. Hence we may underſtand how it has happened that gneiſs ſhould ſometimes be found in granite*, and ſometimes maſſes of granite in the midſt of gneiſs, and why in mountains, granite, gneiſs and ſhiſtoſe mica frequently alternate with each other. Charpent. 390.

As the fluid from which theſe cryſtallized granitic maſſes ſubſided was of the moſt heterogeneous kind it is not to be wondered at that various metallic ſubſtances, and particularly iron, and even ſome traces of carbon and plumbago, ſhould ſometimes occur in them. 2 Sauſs. 451. 2 Bergm. Jour. 1790. 532.

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* Werner kurze Claſſif. 9, 10.

In other tracts where the ſame earths occurred, but not in the proportions fitted to produce granitic ingredients, other maſſes of the ſiliceous genus, as ſiliceous ſhiſtus, ſiliceous porphyries, jaſpers, &c. were formed by a leſs perfect and confuſed cryſtallization.

In various places argillites, hornblende ſlates, ſerpentines and other primæval ſtones of various denominations muſt have ariſen according to the predominant proportion of their ingredients by a more or leſs perfect or partial cryſtallization.

Metallic ſubſtances (all of which I ſuppoſe to have originally exiſted in their complete metallic ſtate) and particularly iron, of all others the moſt copious, muſt in ſundry inſtances have met and combined with ſulphur, the ſubſtance to which all and particularly iron has the greateſt affinity, and thus pyritous ſubſtances and ſulphurated ores originated. Petrol, ſpecifically lighter indeed than water, but involved in the chaotic fluid, meeting ſulphur to which it has an affinity, with it formed a liquid ſpecifically heavier, which gradually involved and was abſorbed by carbonic particles which were thus collected and precipitated.

It is a fact at preſent well eſtabliſhed, that in the act of cryſtallization a very conſiderable degree of heat is generated. Judging then by analogy, how great then muſt have been the heat produced by the cryſtallization of ſuch immenſe quantities of ſtony maſſes as took place at this period, the immediate effect of which muſt have been an enormous and univerſal evaporation, ſweeping over the ſurface of the heated fluid according to the inequality of its diffuſion and the cauſes that produced it in various tracts.

The heat thus produced muſt have been ſtill farther increaſed in conſequence of an event which naturally reſulted from the degree at firſt excited. For in conſequence of the evaporation the quantity of the chaotic fluid (the univerſal menſtruum), as alſo its ſpecific gravity, were diminiſhed, and thus the ſubſtances contained in it (of which it was not the moſt natural ſolvent) were ſtill more diſpoſed to precipitation, as uſually happens in ſuch caſes ; thus then the ferruginous particles naturally not ſoluble while in this metallic ſtate in any fluid, and of which immenſe quantities exiſted, were rapidly and copiouſly precipitated ; the aqueous particles intercepted between them muſt in that caſe have been decompoſed, and an immenſe quantity of inflammable air ſet looſe, the heat thus produced increaſing with the maſſes operated upon, muſt have riſen at laſt to incandeſcence; in that circumſtance the oxygen abſorbed muſt have been in great meaſure expelled, and in its naſcent ſtate meeting and uniting with the inflammable air muſt have burſt into flame. The progreſs of ſuch high degrees of heat muſt have diſengaged all the oxygen contained in the contiguous chaotic fluid, which uniting partly with more metallic iron, partly with the ſulphurated and partly with the carbonic and bituminous ſubſtances muſt have occaſioned a ſtupendous conflagration, the effects of which may well be ſuppoſed to have extended even to the ſolid baſis on which the chaotic fluid repoſed, and to have rent and ſplit it to an unknown extent.

THAT flame ſhould thus burſt from the boſom of the deep is not a forced ſuppoſition, but has frequently been verified in latter times. I ſhall only mention one inſtance which happened in the beginning of this century, when flames burſt out of the ſea near Tercera, and an iſland was elevated*.

THESE volcanic eruptions, many of which ſeem to have taken place at this period, chiefly in the ſouthern hemiſphere, were attended with important conſequences; the firſt muſt have been the diffuſion of a conſiderable heat through the whole maſs of the chaotic fluid, by which means the oxygen and mephitic airs diſperſed through it muſt have been extricated, and thus gradually formed the *atmoſphere*.

THE ſecond was the production of fixed air from the union of oxygen with the ignited carbon; this at firſt roſe into and diffuſed itſelf through the atmoſphere, but in proportion as the chaotic fluid cooled it was gradually abſorbed by it. This abſorbtion occaſioned the precipitation, and more or leſs regular cryſtallization of the *calcareous* earth, the greater part of which being much more ſoluble than the other earths, ſtill remained in ſolution after the others had for the moſt part been depoſited. This explains why many of theſe primitive calcareous maſſes are of all others the freeſt from foreign admixture. In ſome few inſtances however it muſt have happened that the calcareous particles intermixed with other earths were ſaturated before the reunion and depoſition of the other earths, and hence in ſome countries ſtrata of primitive calcareous maſſes occur in the midſt of gneiſs, or alternating with it; but theſe inſtances are very rare.

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* 6 Phil. Tranſ. Abridg. 2d Part, 203.

THAT the formation of fixed air was an event ſubſequent to the formation of moſt of the primæval ſtones, appears from the obſervation, that the calcareous earth found in the compoſition of primæval ſtones is in a cauſtic ſtate. 44 Roz. 206.

THE immenſe maſſes concreted and depoſited on the interior nucleus of the earth formed the *primitive mountains*. It may perhaps be thought that this depoſition ſhould be equally diffuſed and ſhould conſtitute only an even cruſt over this interior nucleus, but ſuch a diſpoſition is contrary to the nature of cryſtallization, between whoſe ſhoots an interval always intercedes, if not too ſudden. The water firſt diſcharged of its diſſolved contents, and thereby heated, moved upwards, being preſſed by the circumambient denſer fluid, which was too heterogenous to mix with, and be diluted by it. The depoſit already formed affording to the ſucceeding portions of the charged fluid a baſis whoſe points of contact were ſo much the more numerous as its height was greater, thereby determined theſe portions to a ſimilar depoſition, until the diminiſhed denſity or exhauſtion of the menſtruum diminiſhed or put an end to the number and extent of the points of contact of the depoſited maſſes with the ſolids contained in the menſtruum. In ſome caſes alſo, particularly after the chaotic fluid was heated by the cauſes already mentioned, and a conſiderable evaporation had enſued, the cryſtallization might have begun at the ſurface, as we ſee happen to ſome ſalts and to lime-water. Thus extenſive ſtrata might have been ſucceſſively depoſited, moſtly in an horizontal, but often from accidental ruptures during their fall, in an oblique or nearly vertical poſition. Thus far we are led by general analogies, without the aſſiſtance of romantic or gratuitous hypotheſes, and the view of the ſubject thus obtained is ſufficient for the explanation of moſt of the obſervations hitherto made on the ſtructure of primitive mountains.

THE formation of *plains* is eaſily underſtood, in the wide intervals of diſtant mountains, after the firſt cryſtallized maſſes had been depoſited, the ſolid particles ſtill contained in the chaotic fluid, but too diſtant from each others ſphere of attraction to concrete into cryſtals, and particularly thoſe that are known to be leaſt diſpoſed to cryſtallize, and alſo to have leaſt affinity to water, were gradually and uniformly depoſited. Of this nature argillaceous particles are known to be, intermixed as may well be expected with a large proportion of ſiliceous and ferruginous particles of all others the moſt abundant, and ſome particles of the other earths; by theſe compound and ſlightly concreted earths the ſurface of plains were originally covered. In proceſs of time theſe earths undoubtedly received an abundant increaſe from the decompoſition of primitive mountains, but this being an event of a poſterior date need here be only curſorily mentioned.

The next important event neceſſary to fit the globe for the reception of land animals was the diminution and receſs of the chaotic fluid in whoſe boſom the mountains were formed, and the conſequent diſcloſure of the dry land. This event was the natural conſequence of the operation of the preceding volcanos, by theſe the bed of the ocean was ſcooped, moſt probably as we ſhall hereafter ſee, in the *Southern* hemiſphere. But no change or tranſpoſition of the ſolid materials depoſited from the chaotic fluid could lower its level, unleſs the inferior *nucleus* of the globe could receive it within its hollow and empty caverns; this admittance it gained through the numerous rifts occaſioned by the antecedent fires; at firſt rapidly, but afterwards more ſlowly, in proportion as the perpendicular height of the fluid was diminiſhed, and thus the emerged continent conſiſting of mountains and plains was gradually laid bare and dried, and by drying, conſolidated.

The diſcloſure of the actual continents, as I have juſt hinted, appears to have been gradual. The tracts at firſt uncovered were thoſe whoſe height over the preſent ſeas amounts to 8500 or 9000 feet, or more. This height comprehends moſt of the Eaſtern heights of Siberia, between latitude 49° and 55°, and of the extenſive regions of Great Tartary, Thibet, the deſert of Coby or Chamo, and China, reaching in ſome places to latitude 35°, and extending in the Northern parts from the ſources of the Irtiſh, long. 95°, and in the more Southern from the heads of the Ganges and Bourampooter, long. 80°, Hohanho and Porentſho to long. 190° at the leaſt, and perhaps ſtill farther into the unknown parts of Eaſtern America.

In Europe only the ſummits of the Alps, Pyrenees, and of a few other mountains were uncovered, but in America the narrow but long chain of the Cordeliers muſt have raiſed its ſummits far above the ocean; this fact is a neceſſary inference from that which I am next to mention.

The level of the antient ocean being lowered to the height of 8500 or 9000 feet, then and not before, it began to be peopled with *fiſh.* I ſhall therefore from its ſimilitude to our preſent *ſeas* henceforward denote it by this denomination, to diſtinguiſh it from the *chaotic fluid*, whoſe compoſition was ſo different and contained no fiſh.

That the creation of fiſh was an event ſubſequent to the emerſion of the tracts juſt mentioned and to the reduction of the waters to the height I have ſtated, is proved by the obſervations of all thoſe who have viſited thoſe countries. Pallas informs us that the immenſe deſert of Cobea or Chamo forms a flat platform whoſe elevation can be compared only to that of Quito in Peru (which Bouguer has ſhewn to amount to upwards of 9000 feet) and that the *plains* of the Monguls all along to the Chineſe wall are nearly of the ſame height *.

MAJOR RENNEL, in his account of the map of India, tells us that the country of Thibet is one of the higheſt in Aſia, being part of that elevated tract which gives riſe not only to the rivers of India and China, but to thoſe of Siberia and Tartary. The Southern ridge of the mountains of Boutan (Thibet) riſes, he ſays, about a mile and a half above the plains of Bengal, and may be ſeen in a horizontal diſtance of one hundred and fifty miles, p. 93 and 94, which indicates a height of fifteen thouſand feet, or allowing for refraction according to Dr. Maſkelyne's rule, eleven thouſand nine hundred and eighty-one feet.

ACCORDING to Abbé Man's calculations, of all others the moſt accurate and the moſt moderate, the height of the Ganges and Hohanho, even at one thouſand miles diſtance from the ſea, muſt be three thouſand ſix hundred and thirty feet. But Major Rennel has ſhewn in the Philoſophical Tranſactions, 1781, p. 90,

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* 1 Act. Petrop. 1777, p. 38.

p. 90, that the head of the Ganges is two thouſand miles diſtant from the ſea, therefore the country it flows from is elevated at leaſt eight thouſand eight hundred or nine thouſand feet.

Now in theſe elevated tracts no marine ſhells or petrifactions are found in the body of any mountain, nor in any ſtone not even in limeſtone though it abound particularly about the ſources of the Amour, Herm. 1 Chy. An. 1791, p. 155. But all the calcareous maſſes that occur are either what are called *ſaline* like Carrara marble, or ſo fine grained foliated as to appear nearly compact, but of the primitive kind. This abſence of marine ſhells and petrifactions from ſuch extenſive regions has attracted the particular notice of all travellers into theſe parts as they are ſo abundantly found in all lower tracts of the globe, Gmelin, 45. Phil. Tranſ. 254. Pallas, 1 Act. Petrop. 44. Patrin, 38 Roz. 227. And though ſalt ſprings and lakes are found in the higheſt plains, Pallas, ibid. 38, and even coal mines in the mountains, yet no organic remains accompany theſe mines as they do in the lower tracts of the globe, Patrin, 38 Roz. 226. Pallas indeed remarks ſome few petrifactions have been found in the rifts even of granitic mounts, but theſe he rightly judges were depoſited there at the time of the deluge; ibid. 44.

Hence I think it follows evidently that theſe tracts were indeed formed in the boſom of the primitive ocean, like all others, but that they were uncovered before the creation of fiſh, and ſince they contain limeſtone, that this ſtone does not neceſſarily and univerſally originate from comminuted ſhells, as Buffon and others have advanced.

THAT fiſh did not exiſt until the level of the ocean was depreſſed to eight thouſand five hundred feet may alſo be inferred with equal evidence from this obſervation, that tho' ſeveral lofty mountains at preſent exiſt which far exceed that height, yet no petrifactions or ſhells are incorporated in the rocks or ſtrata that form them. This De la Peyrouſe atteſts with reſpect to the Pyrenees, which yet are moſtly calcareous. *Traite des Mines de fer*, 336. Nor are any found in *Santo Velino*, the higheſt of the Appennines, its height being eight thouſand three hundred feet, whereas they abound in thoſe that are lower. In the Savoyan Alps Salenche, Saleve Mole, the Dole, all of which are calcareous, but below the height of ſeven thouſand feet, contain petrifactions, but the Buet, which is alſo calcareous for the greater part, but whoſe height exceeds ten thouſand feet, contains none. Sauſſure paſſim.

AND reciprocally of the mountains that *contain* petrifactions imbodied in their maſs none reaches to the height of eight thouſand ſix hundred feet. With reſpect to the Hartz, Laſius remarks that no petrifactions are found in the mountains whoſe height exceeds two thouſand three hundred and ten feet, Laſius, 148; and Renovants, p. 76, aſſerts that none of thoſe of Siberia on each ſide of the Altai exceed two thouſand Paris feet. Nay Pallas does not allow to calcareous mountains that contain petrifactions (which on this account he judges to be formed in the ſea) above thirteen or fourteen hundred feet, 1 Act. Petrop. 59, but a view of the mountains of Switzerland ſhews that many of them are much higher.

The neareſt approach I have met with, to the limits I have aſſigned to the height of the antient ocean when it began to be peopled with fiſh, is an obſervation of Mr. De Luc's, that he found cornua ammonis petrified on mount Grenier, whoſe height is ſeven thouſand eight hundred feet, 2d Lettres a la Reine, 227; and another of Baron Zoits on the mountain of Terglore in Carniola, that petrifactions were found in limeſtone at the height of between thirteen and fourteen hundred German lachters, taking ſuch to be equal to thoſe of the Hartz, the height was eight thouſand five hundred Engliſh feet nearly, and hence I have extended the limits to eight thouſand five hundred feet, yet it does not appear by Mr. De Luc's relation that theſe petrifactions were imbodied in the ſtone or rock which conſtitutes the mountain, and therefore may well be only relics of the deluge. He alſo ſays that the chain of Jura abounds in marine remains, but Jura conſiſts of two chains, the higheſt of which conſiſts of primæval limeſtone in which no petrifactions are found, and this is the higheſt, 30 Roz. 275, but the lower chain certainly abounds in them. Fichtel alſo remarks that ſtill higher on the mountains of Terglore no petrifactions are found imbodied, Mineral Aufsatz, p. 4.

AFTER this elevated tract of the globe had been uncovered, there is no reaſon to ſuppoſe that it long remained diveſted of vegetables or unpeopled by animals, being in every reſpect fitted to receive them. The ſevere degree of cold which at preſent diſtreſſes theſe countries during the winter months is ſolely owing to their diſtance from and elevation over the actual ſeas (as I have elſewhere ſhewn), circumſtances that did not exiſt at this period.

THAT the retreat of the ſea from the lower parts of our preſent continents was gradual and not fully effected until after the lapſe of ſeveral centuries many reaſons induce us to believe. 1°. Both ſides of the Altaiſchan platform exhibit ſecondary mountains (ſo I call all thoſe which contain marine ſhells or other remains of animal or vegetable ſubſtances between their ſtrata, or incorporated in the rocks or ſtones of which they conſiſt) both of the calcareous and argillitic kind, in which marine ſhells abound, Renov. 75, theſe therefore muſt have been formed before the ſea had receded far from theſe parts, and muſt have been the work of many years.

2do. NOT only in every region of Europe but alſo of both the old and new continents, whoſe ſituation is inferior to that abovementioned,

mentioned, immenſe quantities of marine ſhells either diſperſed or collected have been diſcovered. In the province of Touraine in France, at one hundred miles diſtance from the ſea, there exiſts at a depth of eight or nine feet a heap of ſhells of nine leagues in ſurface and upwards of twenty feet in depth, many of which are thoſe of the neighbouring ſeas, a collection which certainly required many years to accumulate.—Mem. Paris, 1720. p. 524, 540. Moſt of theſe ſhells are placed on their flat and not on their convex ſurface.—Ibid. which ſhews they muſt have been gently depoſited, and not huddled together by a ſudden and violent inundation. In ſome places ſhells of different ſpecies are thus accumulated, but in others they are regularly arranged in families.—1 Bergm. Erdekug. 251, 262. 6 Roz. 120. Widem. Verwandl. 118. which ſhews alſo that they were neither ſuddenly nor promiſcuouſly collected. Many ſmaller but ſimilar accumulations occur in England, as may be ſeen in the Philoſ. Tranſ. and Ray's Diſcoveries, and in Peru 2 Don. Ulloa's Voy. 197. and alſo in Italy, Spain, Germany, Poland, Sweden, &c. which being generally known and acknowledged it is needleſs to detail, but it deſerves particular attention, though many of them are found at a depth of from eight to one or two hundred feet under the ſurface of the earth, and at ſtill greater depths from the ſurface of mountains, yet ſcarce any are found lower than the actual ſurface of the bed of the ſea.—1 Bergm. Erde, 176. Some indeed are found that do not now occur in the neighbouring coaſt, becauſe they are of the kind called *Pelagicæ*, which exiſt only at great depths, as Don Ulloa has ſhewn, 2 Voy. 197. or becauſe the temperature of the actual ſeas is unfit for them, as the ancient ſeas, from the ſmaller extent of the ancient continents, muſt have been much warmer, nay the number of theſe unknown ſhells is daily diminiſhing.

We may alſo remark that the loweſt countries, as Brabant and Holland, contain moſt of them. In particular tracts of Ruſſia they are alſo very copious, becauſe theſe tracts were longer covered by the ſea than moſt other countries, as will be ſhewn in a future Eſſay.

4°. Trees of different kinds and various vegetables have been found in great depths in our modern continents, and even under lofty mountains, as at Meiſſen in Heſſia, and often mixed with marine remains. Some parts of the earth on which theſe trees grew muſt therefore have been dry land, while thoſe parts in which the trees are found were covered by the ſea, therefore the retreat of the ſea muſt have been gradual. Many I am ſenſible aſcribe theſe depoſitions to the ravages of the univerſal deluge, and in ſome caſes I believe juſtly, but as they are often under hills or mountains, whoſe ſtrata are regularly diſpoſed, a regularity that can ſcarce be ſuppoſed to take place during the turbulence of a deluge, in theſe caſes it appears their depoſition muſt be aſcribed to more tranquil cauſes.

5°. Trees have often been found depoſited near the ſummits of many mountains at heights in which from the degree of cold which at preſent prevails on them they could not grow, therefore they muſt have grown when the temperature of theſe ſummits was warmer, and conſequently when they were leſs elevated over the ſurface of the ſea, and leſs diſtant from it.

Lastly,—Stratified mountains of various heights beneath eight thouſand feet exiſt in different parts of Europe, and of both continents, in and betwixt whoſe ſtrata various ſubſtances of marine, and ſome vegetables of terreſtrial origin repoſe, either in their natural ſtate or petrified; the regularity and uniformity of theſe ſtrata ſtrongly indicate a cauſe whoſe action was regular and uniform and long continued; now tides are the only cauſe of this nature with which we are acquainted; ſudden and violent inundations and of ſhort continuance are incompatible with ſtratifications ſo regular and numerous. In ſome few inſtances, it is true, much irregularity and confuſion prevails amongſt the ſtrata, from the diſſolution, elapſion, or different compreſſion of ſome of theſe ſtrata, or from their interruption during their formation, by the introduction of extraneous rocks projected amongſt them by adventitious cauſes, as earthquakes or volcanos; or the tides themſelves may have ſometimes been rendered irregular by ſtorms, currents or the irregular profile of the ſhores, as we daily obſerve. But even in theſe caſes the length of time neceſſary for the formation of the ſtrata exclude all ſuſpicion of ſhort and tumultuary inundations.

We alſo obſerve, that though the ſtrata themſelves are not arranged in the order of the ſpecific gravities of the materials that compoſe them, the lighter being frequently placed beneath the heavier, yet within each ſtratum the materials that compoſe it are almoſt always arranged according to the laws of their gravitation. 1 Bergm. Erde, 179.

These phænomena fully prove that the retreat of the ſea from the vicinity of the lofty mountains and elevated platforms that firſt emerged was not ſudden, but continued for ſeveral ages, and that the various ſtratified ſecondary mountains at preſent exiſting were formed within it during its retreat, and after the creation of fiſh. The mode of their formation now claims our attention.

To form as juſt an idea of the formation of ſecondary mountains as the nature of an object inſcrutable to human eyes can allow us, we muſt obſerve, 1°. That the greater part of the particles of ſolid matter contained in the chaotic fluid being depoſited before the creation of fiſh, the various materials that enter into the compoſition of ſecondary mountains muſt have been furniſhed either by the deſtruction of ſuch of the primary as exiſted in the ſea, but either from want of ſolidity or the ſmallneſs of their maſs were too feeble to reſiſt its impetuoſity when animated by ſtorms; and being by continued friction reduced to atoms or rolled into tumblers were either diffuſed through or hurried along by the agitation of the waters, or were crumbled to pieces by earthquakes, and variouſly diſperſed through the ocean, or theſe materials were ejected in immenſe heated maſſes, by ſubmarine volcanos into the boſom of the waves, to be by them farther comminuted, diſintegrated or decompoſed.

The various ſolids thus diffuſed at different periods of time through the vaſt body of the ocean muſt have been gradually precipitated and depoſited on ſuch ſolid maſſes as reſiſted the progreſſive motion impreſſed upon the precipitating maſſes by that tumultuous element; hence they applied to and reſted on the low lateral ſurfaces of many of the moſt conſiderable primary mountains, or were accumulated on the ſcabrous but firmly rooted fragments of ſuch of thoſe mountains as were before deſtroyed, intombing the ſhell-fiſh that adhered to or reſted upon theſe fragments, and arreſting by their initial ſoftneſs the various ſunk woods and other vegetable or animal ſubſtances as chanced to be mixed with theſe precipitating maſſes, or were ſubſequently borne upon them. Trees naturally aſſumed the ſituation that afforded leaſt reſiſtance to the currents that conveyed them, and hence the uniformity that has been obſerved very frequently in their poſition. Theſe depoſitions, when during their deſcent they attained a certain degree of denſity, muſt have proved fatal to the various ſpecies of fiſh which were involved in them, and hence the origin of the more ſolid piſcine remains at preſent found in them; the ſofter parts being deſtroyed by putrifaction, in this manner, but after long intervals of time, the ſucceeding ſtrata appear to have been formed, but they did not attain their preſent ſolidity until after the retreat of the ſea, and through the operation of cauſes which I ſhall preſently mention.

FROM the circumſtances here ſtated we may eaſily account for ſeveral of the moſt general geological obſervations, as,

1°. WHY ſtratified hills have always been found repoſing on primary rocks or inveſting primary mountains, as on granite, gneiſs, argillite, &c. as Ferber, Born, Pallas, Gerhard, Charpentier, Werner, Sauſſure, &c. atteſt, not as matters of opinion, but as facts they have conſtantly been witneſſes to. Doctor Hutton indeed thinks this obſervation does not hold true with reſpect to Scotland, or even with reſpect to the greater part of Britain, becauſe in traverſing the greater part of that iſland he ſeldom met with granite; but it is plain from what has been ſaid, that it is not on the ſurface it ſhould be expected, but under the ſuperior ſtrata, therefore the Doctor's obſervations, but not his aſſertions, are perfectly conſiſtent with thoſe of all other geologiſts. However Mr. Everſman of Berlin, who reſided ſome years in Scotland, tells us that the fundamental rock (*Grundgebirge*) of Scotland is a maſs of the *granitic kind*, 1 Bergm. Jour. 1789, 495, and Doctor Aſh relates that not only near Aberdeen, but in the more ſouthern parts, extenſive granitic mountains often occur, 1 Chy. Ann. 1792, 115. The truth is that the whole of Britain ſeems to have been formed of ſtrata, reſting upon and intercepted between maſſes of granite or other primitive rocks, at depths in moſt places not eaſily acceſſible.

2do. Why the ſtrata of ſecondary mountains are generally elevated in the direction that faces the next primitive mountains, though frequently diſtant from them, being as we have ſeen originally formed againſt, and along the ſloping ſides of thoſe mountains, and the ſeparation occaſioned by the courſe of waters that formed the vallies that intercede between them. The ſeeming exceptions to this rule ariſe either from the ſinking of the primitive mountain to which the ſecondary faced, as happened to that which ſtood where the lake of Geneva is now placed, whoſe bottom is chiefly granite, or ſome other primitive rock, as Mr. Sauſſure atteſts, 1 Sauſſ. 15, and therefore the elevation of the ſtrata of the Mole, Saleve, &c. face the lake, Id. p. 222, 223, &c. or becauſe theſe ſtratified hills were originally independent, being formed on the fragments of primitive mountains, as already ſaid.

Hence alſo we may explain an important obſervation made by Mr. Schreiber on the mountain of Gardette, which conſiſts of limeſtone ſuperimpoſed on gneiſs; he obſerved that where they joined, the gneiſs had penetrated into the body of the limeſtone, but the limeſtone did not penetrate into that of the gneiſs, whence he juſtly inferred that the limeſtone was in a ſoft ſtate, but the gneiſs already conſolidated, when the contact took place; 36 Roz. 359. Similar to this is the obſervation of Mr. Sauſſure, 1 Sauſſur. 528, that a puddingſtone with a calcareous cement or argillaceous grit is generally interpoſed betwixt the uppermoſt ſtrata of the primary and the loweſt of the ſecondary ſtrata as the ſoft ſecondary matter inveloped the *pebbles* or *gravel* on the ſurface of the primary; this he obſerved in the Alps, the Voſges, the Cevennes, &c. This is alſo conſtantly obſerved in coal mines where ſemi-primigenous ſtrata (Todliegendes) a ſandſtone or brecia with a calcareous or argillaceous cement, forms the laſt ſtratum immediately over the primitive rock.

MANY, indeed moſt of the obſervations hitherto made, are explicable on theſe principles, which, not to extend this part of the Eſſay beyond its due limits, I here omit.

THE retreat of the ſea appears to have continued through the rifts already mentioned, or poſſibly through others ſubſequently made, probably until a few centuries before the deluge. Its ceſſation long before the deluge I infer from the hardneſs which the mountains muſt have acquired to withſtand the ſhocks they muſt have underwent during that cataſtrophe. To acquire this hardneſs a long period of time was neceſſary, both for their deſiccation and the infiltration of thoſe particles to which the ſtrata of ſecondary mountains owe their ſolidity.

I DO not by this pretend that the ſecondary ſtrata had not acquired a certain degree of ſolidity in a few minutes, even after their depoſition, and conſequently long before their emerſion; on the contrary this muſt ſoon have been acquired in the ſame manner as we find calcareous depoſits to harden at the bottom of ſalt-pans and tea-kettles, while full of liquor, and tartar in hogſheads of wine, and pouzzolana mortar, &c. but this hardneſs is moderate in compariſon of that which they acquired by deſiccation and continued infiltration, as we daily experience in moiſt limeſtone quarries, where though the ſtone is originally hard, yet it becomes much harder when dried. The induration effected by infiltration is ſtill more conſiderable, as by it the minuter particles of bodies are conveyed into the minuteſt interſtices. Hence we ſee that traps and baſaltic pillars are always harder at the bottom than at the top, Cronſt. § 267, and the upper ſtrata of limeſtone, particularly of that ſpecies called freeſtone, are always ſofter near the ſurface of the quarry than at a greater depth; that ſuch infiltration is not an imaginary proceſs, let it be explained how it may, and conſequently that the hardneſs of the lower ſtrata does not proceed merely from the preſſure of the upper, appears by an elegant obſervation of Mr. Werner's, that where various ſtrata of a different nature occur, the petrifactions that are found in the inferior, are frequently filled with the matter of the ſuperior inſtead of that of the ſtratum which contains them, Wedem. Verwandl. 118. The petrified ſhells found in clay or argillites are commonly compreſſed and flatted, as Mr. Bergman remarks, as argil hardens by contraction, but thoſe found in limeſtone retain their primitive ſhape, as theſe harden chiefly by infiltration.

I NOW proceed to the Moſaic account of theſe events, " In " the beginning God created the heaven and the earth," that is to ſay, the firſt event in the hiſtory of this globe was its creation, and that of all the planets then known.

" AND the earth was without form and void," that is to ſay, that the earth at the time of its creation was without form, &c. therefore another terraqueous globe did not previouſly exiſt in a *complete ſtate* out of the ruins of which the preſent earth was formed, as ſome have lately imagined; *without form and void* the Hebrew has *Tohu* and *Bohu.* Ainſworth remarks that *Tohu* ſignifies a ſtate of confuſion, and *Bohu* a ſtate of vacuity; ſee Pool's Synopſis. That is to ſay, that the earth was partly in a *chaotic* ſtate, and partly full of *empty* cavities, which is exactly the ſtate, which from the conſideration of the ſubſequent phenomena, I have ſhewn to have been neceſſarily its primordial ſtate.

" AND darkneſs was on the face of the deep," conſequently light did not at firſt exiſt. The *deep*, or abyſs, properly denotes an immenſe depth of water, but here it ſignifies, as Mede and Eſtius obſerve, the mixed or chaotic maſs of earth and water.—David, whoſe knowledge was derived from Moſes, and who probably poſſeſſed a leſs abridged copy of Geneſis than we do, expreſsly tells us that the earth was covered with water;" the abyſs, like a garment, " was its covering." Pſalm civ. v. 6.

HENCE we ſee that the water was from the beginning in a liquid ſtate (and not in that of ice) as I have mentioned; and conſequently elementary fire, or the principle of heat, exiſted from the beginning.

" AND the ſpirit of God (or rather *a* ſpirit of God) moved on the " face of the waters;" here *ſpirit* denotes an inviſible elaſtic fluid, viz. the great *evaporation* that took place ſoon after the creation, as ſoon as the ſolids began to cryſtallize, as I have ſhewn. *Of God*, is a well known Hebrew idiom denoting *great; moved*, or rather *hovered*, over the waters. David here mentions a fact which he undoubtedly took from Moſes, though omitted in our preſent copies of Geneſis, and this fact is eſſential to our theory, namely, that " the waters ſtood *above the mountains*." Pſalm civ. v. 6. Therefore the mountains were formed in the boſom of the waters, as I have ſtated. Nay he uſes an expreſſion that moſt probably hath hitherto been ill underſtood, that " God fixed the earth on its baſis, from " which it ſhall not be removed for ever." This appears to me to denote the depoſition of the ſolids contained in the chaotic waters, on the ſolid kernel of the globe, from whence they ſhould never be removed nor indeed have they ever ſince.

" And God ſaid let there be light, and there was light;" here we may obſerve that *facts* only, were revealed to Moſes or the perſon (moſt probably Adam) from whom their tradition deſcended. The words choſen by Moſes, or this perſon, were ſuch as coincided with his own notions, or were moſt intelligible to an ignorant people. The phraſes, *God ſaid*, *God ſaw it was good*, *God called*, uſed in this chapter, are mere anthropological phraſes, ſuited to the conception of thoſe to whom theſe facts were related, for religious and moral and not merely for ſcientific purpoſes. To men of ſcience their ſignification could not be ambiguous. " *God ſaid*," ſignifying no more than that events naturally poſſible took place by virtue of the laws of their production, which laws God had eſtabliſhed. " *God ſaw it was good*," ſignifies merely that it was good, and the expreſſion " *God called*," denotes no more than that it received ſuch a name.

THE production of light ſtands next in the order of events recorded by Moſes, as it does in our theory, and moſt probably denotes the *flames* of volcanic eruptions, the Hebrew certainly bears this ſignification. The period of its exiſtence Moſes called *day*, evidently from its reſemblance to *true* days, which could have exiſted only at a ſubſequent period, namely after the ſun had gained its luminous powers.

" AND God ſaid, let there be a firmament in the midſt of the " waters, and let it divide the waters from the waters." Here Moſes indicates the production of the atmoſphere, the word which in our tranſlation is rendered *firmament* * moſt properly ſignifies *expanſe*, or an expanded or dilated ſubſtance; than which a more proper name could not ſurely be choſen for the atmoſphere. "To divide "the waters from the waters," that is, to ſeparate and contain vapours, which is one principal uſe of the atmoſphere.

"AND God ſaid, let the waters under the heavens be gathered "together in one place, and let the dry land appear, and it was "ſo." This is the fifth event which Moſes places in the ſame order of ſucceſſion that mere philoſophical conſiderations aſſign to it.

The word *appear* is remarkable, as it ſeems to denote that the diſcloſure of the earth was *ſucceſſive*, and had not from the beginning fully and compleatly taken place.

THE events immediately ſubſequent I omit, as not relating to geology, and ſhall only mention the creation of fiſh, a fact of great importance in the theory of the earth; this Moſes, as well as philoſophy, tells us happened after the ſeparation of the waters from the dry land and primitive mountains. He alſo relates that the creation of land-animals was ſubſequent to that of fiſh; a fact which geological obſervations alſo indicate, for their remains are always found near the ſurface of the earth, whereas thoſe of fiſh are found at the greateſt depths. This order of ſucceſſion is not only allowed by Mr. Buffon, but made one of the principal pillars of his ſyſtem. 1 Epoque's de la Nature, p. 231 in 8vo.

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* Some interpreters think *firmament* implies ſomething ſolid, becauſe the general opinion of the Heathen oriental ſages was, that the heavens were ſolid, as if the *true ſenſe* of the Hebrew was to be derived from *falſe opinions* deviſed many ages after Moſes.

HERE then we have ſeven or eight geological facts, related by Moſes on the one part, and on the other, deduced ſolely from the moſt exact and beſt verified geological obſervations, and yet agreeing perfectly with each other, not only in *ſubſtance* but in the order of their ſucceſſion. On whichever of theſe we beſtow our confidence, its agreement with the other demonſtrates the truth of that other. But if we beſtow our confidence on *neither*, then their *agreement* muſt be accounted for. If we attempt this, we ſhall find the *improbability* that both accounts are falſe, infinite; conſequently one muſt be true, and, then, ſo muſt alſo the other.

THAT two accounts derived from ſources totally diſtinct from and independent on each other ſhould agree not only in the ſubſtance but in the order of ſucceſſion of two events only, is already highly improbable, if theſe facts be not true, both ſubſtantially and as to the order of their ſucceſſion. Let this improbability, as to the ſubſtance of the facts, be repreſented only by $\frac{1}{10}$. then the improbability of their agreement as to ſeven events is $\frac{1^{\cdot 7}}{10^{\cdot 7}}$, that is, as one to ten million, and would be much higher if the *order* alſo had entered into the computation.

SECOND ESSAY

ON THE

DELUGE.

HAVING, I flatter myſelf, eſtabliſhed, in the preceding Eſſay, the credit due to Moſes on mere philoſophic grounds, and abſtracting from all theological conſiderations, I ſhall not ſcruple taking him as a guide as far as his teſtimony reaches, in tracing the circumſtances of the moſt horrible cataſtrophe to which the human and all animal ſpecies, and even the terraqueous globe itſelf, had at any period ſince its origin been expoſed. His teſtimony is indeed in ſubſtance confirmed by the traditions of many antient nations, which may be ſeen in Grotius de Veritate Huet Queſt. Alnet. lib. ii. chap. xii. Euſeb. Prep. Evang. Lib. ix. &c. and therefore needleſs to adduce; it is more to our purpoſe to prove it by geological facts, of which there are ſome that ſeem to me perfectly concluſive.

1ſt, According to Don Ulloa, ſhells were found on a mountain in Peru at the height of 14220 feet, 2 Buff. Epoque, 268. Now I have already ſhewn, in the former Eſſay, that no mountains higher than 8500 feet were formed ſince the creation of fiſh, or, in other words, that fiſh did not exiſt until the original ocean had ſubſided to the height of eight thouſand five hundred feet above its preſent level. Therefore the ſhells found at more elevated ſtations were left there by a ſubſequent inundation. Now an inundation that reached ſuch heights could not be partial, but muſt have extended over the whole globe.

2dly, The bones of elephants and of rhinoceri, and even the intire carcaſe of a rhinocerus, have been found in the lower parts of Siberia. As theſe animals could not live in ſo cold a country they muſt have been brought thither by an inundation from warmer and very diſtant climates, betwixt which and Siberia mountains above nine thouſand feet high intervene. It may be replied that Siberia, as we have already ſhewn, was not originally as cold as it is at preſent; which is true, for probably its original heat was the ſame as that of many iſlands in the ſame latitude at this day, but ſtill it was too cold for elephants and rhinoceri, and between the climates which they might have then inhabited and [the places they are now found in too many mountains intercede to ſuppoſe them brought thither by any other means but a *general* inundation. Beſides, Siberia muſt have attained its preſent temperature *at the time* theſe animals were tranſported, elſe they muſt have all long ago putrified.

3dly, Shells known to belong to ſhores under climates very diſtant from each other are in ſundry places found mixed promiſcuouſly

cuouſly with each other; *one ſcrt* of them, therefore, muſt have been tranſported by an inundation; the promiſcuous mixture can be accounted for on no other ſuppoſition.

THESE appear to me the moſt unequivocal geologic proofs of a general deluge. To other facts generally adduced to prove it, another origin may be aſcribed; thus the bones of elephants found in Italy, France, Germany, and England, might be the remains of ſome brought to Italy by Pyrrhus or the Carthaginians, or of thoſe employed by the Romans themſelves; ſome are ſaid to have been brought to England by Claudius. 4 Phil. Tranſ. Abr. 2d part, 242. When theſe bones, however, are accompanied with marine remains, their origin is no longer ambiguous. Thus alſo the bones and teeth of whales, found near Maeſtricht, are not deciſively of diluvian origin, as whales have often been brought down as low as Lat. 48°. 34 Roz. 201. Nay ſometimes they ſtrike on the coaſt of Italy. 1 Targioni Tozzetti 386.

YET, to explain the leaſt ambiguous of theſe phœnomena, without having recourſe to an univerſal deluge, various hypotheſes have been framed.

SOME have imagined that the axis of the earth was originally parallel to that of the ecliptic, which would produce a perpetual ſpring in every latitude, and conſequently that elephants might exiſt in all of them. But the ableſt aſtronomers having demonſtrated the impoſſibility of this paralleliſm, it is unneceſſary to examine its conſequences; it only deſerves notice that the obliquity of the equator is rather diminiſhing than increaſing. See La Lande in 44 Roz. 212. Beſides, why are theſe bones accompanied by marine remains? Others, from this nutation of the earth's axis, have ſuppoſed that its poles are continually ſhifting, and conſequently that they might have originally been where the equator now is, and the equator where the poles now are; thus Siberia might have, in its turn, been under the equator. But as the nutation of the earth's axis is retrogreſſive every nine years, and never exceeds ten degrees, this hypotheſis is equally rejected by aſtronomers. 44 Roz. 210. 2 Bergm. Erde Kugel 305. The pyramids of Egypt demonſtrate that the poles have remained unaltered theſe three thouſand years.

The 3d hypotheſis is that of Mr. Buffon, to which the unfortunate Bailly has done the honour of acceding; according to him the earth, having been originally in a ſtate of fuſion, and for many years red hot, at laſt cooled down to the degree that rendered it habitable. This hypotheſis he was led to imagine from the neceſſity of admitting that the globe was, at leaſt to a certain diſtance beneath its ſurface, originally in a ſoft ſtate; the ſolution of its ſolid parts in water he thought impoſſible, falſely imagining that the whole globe muſt have been in a ſtate of ſolution, whereas the figure of the earth requires the liquidity of it only a few miles beneath its ſurface. Epoques, 10. and 35. If he had trod the path of experiments he would have found both the hardneſs and tranſparency, of what he calls his primitive glaſs, and thinks the primitive ſubſtance of the globe, namely *quartz*, to be altered in a ſtrong heat with a loſs of 3 per cent. of its weight, and that ſo far from having been a glaſs, that it is abſolutely infuſible. The loſs of weight, he muſt have ſeen, could be aſcribed to nothing elſe but the loſs of its watery particles, and that therefore it muſt have been originally formed in water; he would have found that ſome *felſpars* loſe 40 per cent. and others at leaſt 2 per cent. by heat; he would have perceived that *mica*, which he thinks only an exfoliation of quartz, to be in its compoſition eſſentially different. He certainly found their cryſtallization inexplicable, for he does not even attempt to explain it.

But waving this, and a multitude of other inſuperable difficulties in his hypotheſis, and adverting only to the ſolution he thinks his theory affords, of the phœnomenon of the exiſtence of the bones of elephants, and the carcaſe of a rhinoceros in Siberia, I ſay it is defective even in that reſpect. For allowing his ſuppoſition that Siberia was at any time of a temperature ſo ſuited to the conſtitution of theſe animals that they might live in it, yet the remains lately found in that country cannot be ſuppoſed to belong to animals that ever lived in it:

1ſt, Becauſe though they are found at the diſtance of ſeveral hundred miles from the ſea, yet they are ſurrounded by genuine marine vegetables, which ſhews that they were brought thither together with thoſe vegetables.

2dly, Becauſe they are generally found in accumulated heaps, and it is not to be imagined that while alive they ſought a common burial place no more than they at preſent do in India.

3dly, Becauſe the rhinoceros was found intire and unputrified, whereas if the country was warm when he periſhed this could not have happened.

4thly, Becauſe in no very diſtant latitude *, namely that of Greenland, the bones of whales, and not of elephants, are found on the mountains, conſequently that latitude muſt have been in that ancient period ſufficiently cold to maintain whales, as it is at this day; and that cold we know to be very conſiderable, and incompatible with the proximity of a climate ſuited to elephants. 17 N. Comment. Petropol. 576. 1 Act. Petrop. 55. Renov. 73. Therefore the animals whoſe remains are now found in Siberia could not have lived in it.

The 4th hypotheſis is that of Mr. Edward King, but much amplified and enlarged by Mr. De Luc. This juſtly celebrated philoſopher is of opinion that the actual continents were, before the deluge, the bottom or bed of the ancient ocean, and that the deluge conſiſted in the ſubmerſion of the ancient continents, which conſequently form the bottom or bed of our actual oceans, con-

ſequently

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* The bones were found in latitude 55°.

ſequently our actual mountains were all formed in the antediluvian ocean, and thus ſhells might be left on their higheſt ſummits.

In this hypotheſis the ancient continents muſt have exiſted in thoſe tracts now covered by the Atlantic and Pacific Oceans; if ſo, I do not ſee how the elephants could have been brought into Siberia, or a whole rhinoceros found in it: For Siberia being then the bottom of ſome ocean, the ſea muſt have moved *from it* to cover the ſinking continents, inſtead of moving *towards it*, to ſtrew over it their ſpoils.—If it be ſaid that theſe animals were carried into the ſea before the flood, then, aſſuredly, the rhinoceros ſhould have been devoured, and only his bones left.

To ſay nothing of the incompatibility of this ſyſtem with the principal geologic phœnomena mentioned in my former Eſſay, and of the deſtruction of at leaſt all the graminivorous fiſh that muſt have followed from their transfer to a ſoil not ſuited to them, it is evidently inconſiſtent with the Moſaic account of this cataſtrophe, which account theſe philoſophers however admit.

Moses aſcribes the deluge to two principal cauſes, a continual rain for forty days, and the eruption of the waters of the great abyſs. Now to what purpoſe a rain of forty days to overwhelm a continent that was to be immerſed under a whole ocean? He tells us the waters *increaſed* on the continents a certain number of days, *reſted* thereon another period of days, and then *returned.*

Do not theſe expreſſions imply a permanent *ground* on which they increaſed and reſted, and from which they afterwards retreated? As the retreat followed the advance, is it not clear that they retreated from the *ſame* ſpaces on which they had before advanced and reſted?

Mr. De Luc replies, that in the 13th verſe of the 6th chapter of Geneſis, it is ſaid the earth ſhould be *deſtroyed*, and that Mr. Michaelis ſo tranſlates it. However it is plain, from what has been juſt mentioned, that Moſes did not underſtand ſuch a deſtruction as ſhould cauſe it to diſappear totally and for ever; he tells us that the waters ſtood 15 cubits over the higheſt mountains; now as he has no where mentioned the antediluvian mountains, but has the poſtdiluvian, it is plain that it is to theſe his narration relates, and theſe he tells us were at the time of the deluge covered with water, and uncovered when the waters diminiſhed; he never diſtinguiſhed the poſtdiluvian from the antediluvian, and therefore muſt have conſidered them as the ſame.

Nor did Noah himſelf believe the ancient continents deſtroyed, for he took the appearance of an olive branch to be a ſign of the diminution of the flood. This he certainly believed to have grown on the ancient continent, and could not expect it to have ſhot up from the bottom of the ſea.—Mr. De Luc tells us that this olive grew on an antediluvian iſland, and that theſe iſlands, being part of the antediluvian ocean, were not flooded—it is plain, however, Noah did not think ſo, elſe he would not judge the appearance of the olive to be a ſign of the diminution of the waters.—Where is it mentioned or what renders it neceſſary to infer that iſlands exiſted before the flood? If iſlands did exiſt, and were to eſcape the flood, ſo might their inhabitants alſo, contrary to the expreſs words of the text.

IT would ſurely be much more convenient for Noah, his family and animals, to have taken refuge in one of them, than to remain pent up in the ark.

THE dove, Moſes tells us, returned the firſt time ſhe was let out of the ark, *finding no place whereon to reſt her foot*; ſhe conſequently could not diſcover the iſland, whereas the raven never returned, plainly becauſe he found carcaſſes whereon to feed, therefore theſe carcaſſes were not ſwallowed up, as Mr. De Luc would have it. Moſes tells us that at the ceſſation of the flood the fountains of the deep were ſtopped or ſhut up; therefore, in his apprehenſion, inſtead of the ancient continents ſinking into the deep, the waters of the abyſs flowed from their ſources upon that continent, and again returned; from all which it follows that this hypotheſis is as indefenſible as the foregoing.

Paſſing over the ſyſtems of Burnet, Woodward and Whiſton, which have been repeatedly refuted, I recur to the account of this great revolution given by Moſes himſelf, taken in its plain literal ſenſe, as the only one that appears perfectly conſiſtent, with all the phœnomena now known, of which I ſhall find occaſion to mention many; he plainly aſcribes it to a ſupernatural cauſe, namely the expreſs intention of God to puniſh mankind for their crimes. We muſt therefore conſider the deluge as a miraculous effuſion of water, both from the clouds and from the great abyſs; if the waters, ſituated partly within and partly without the caverns of the globe, were *once* ſufficient to cover even the higheſt mountains, as I have ſhewn in the former Eſſay, they muſt have been ſufficient to do ſo a ſecond time when miraculouſly educed out of thoſe caverns.

Early geologiſts, not attending to theſe facts, thought all the waters of the ocean inſufficient*;* it was ſuppoſed that its mean depth did not exceed a quarter of a mile, and that only half of the ſurface of the globe was covered by it; on theſe *data* Keil computed that twenty-eight oceans would be requiſite to cover the whole earth to the height of four miles, which he judged to be that of the higheſt mountains, a quantity at that time conſidered as extravagant and incredible, but a further progreſs in mathematical and phyſical knowledge has ſince ſhewn the different ſeas and oceans to contain at leaſt forty-eight times more water than they were ſuppoſed to do.

Mr. De La Place, calculating their average depth, not from a few vague and partial ſoundings, for ſuch they have ever been, (the polar regions having been never ſounded, particularly the Antartic) but from a ſtrict application of the theory of tides to the height to which they are known to riſe in the main ocean, demonſtrates that a depth, reaching only to half a league, or even two or three leagues, is incompatible with the Newtonian theory, as no depth under four leagues could reconcile it with the phœnomena *—The vindication of the Moſaic hiſtory does not require near ſo much. The extent of the ſea is known to be far greater than Keil ſuppoſed, that of the earth ſcarcely paſſing $\frac{1}{3}$ of the ſurface of the globe.

THE poſſibility and reality of the deluge being thus eſtabliſhed, I ſhall next endeavour to trace its origin, progreſs, and ſtill permanent conſequences. That it originated in and proceeded from the great ſouthern ocean below the equator, and thence ruſhed on the northern hemiſphere, I take to be a natural inference from the following facts :

1ſt, The ſouthern ocean is the greateſt collection of waters on the face of the globe.

2d, In the northern latitudes beyond 45° and 55° we find the animal ſpoils of the ſouthern countries, and the marine exuviæ of the ſouthern ſeas, but in the ſouthern latitudes we find no remains

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* Mem. Paris, 1776.

remains of animals, vegetables or ſhells belonging to the northern ſeas, but thoſe only that belong to the neighbouring ſeas. Thus in Siberia, to return to the already frequently mentioned phœnomenon, we find the remains of elephants and rhinoceri accompanied by marine vegetables, and alſo with ſhells that do not belong to the northern ocean. 1 Epoques 418. They muſt therefore have been conveyed thither by the more diſtant Indian ſea overflowing theſe parts; as the elephants very naturally crowded together on the approach of the inundation, they were conveyed in flocks, and hence their bones are found in accumulated heaps, as ſhould be expected *. But in Greenland, which is ſtill more diſtant, only the remains of whales are found on the mountains. Crantz Hiſtoire Generale des Voy. vol. xix. 105. So in the ſouthern latitudes, as at Talcaguana in Chili, latitude 36° S. the ſhells found on the tops of the hills are thoſe of the neighbouring ſea. 2 Ulloa Voy. p. 197. So thoſe found on the hills between Suez and Cairo are the ſame as thoſe now found in the Red Sea. Shaw's Voyages, vol. ii.

3dly, The traces of a violent ſhock or impreſſion from the ſouth are as yet perceptible in many countries. This Mr. Patrin atteſts as to the mountains of Dauria on the ſouth eaſt limits of Siberia; he tells us that the more eaſtern extremities of the mountains appear to be broken off by the impetuoſity of an ancient ocean

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* The elephantine remains found in Ruſſia were conveyed thither from Perſia.

ruſhing from eaſt to weſt, that the fragments carried to the weſt in ſome meaſure protected the more weſtern. 38 Roz. 230. 238. And that in general the mountains of this country were ſo diſordered (by the ſhock) that the miners are obliged to work at hazard. Ibid 226. Steller makes the ſame remarks on the mountains of Kamſchatka, 51 Phil. Tranſ. Part ii. p. 479. Storr, Hœpfner & Sauſſure, inform us that the inundation that invaded Swiſſerland proceeded from the ſouth, but its impreſſion was modified by another event which I ſhall preſently mention. 1 Helvet. Magaz. 173. 175. 4 Helvet Magaz. 307. Laſius tells us that the mountains of the Hartz ſuggeſt the ſame inference. Hartz. 95.

4thly, The very ſhape of the continents which are all ſharpened towards the ſouth, where waſhed by the ſouthern ocean, indicate that ſo forcible an impreſſion was made on them as nothing but the mountains could reſiſt, as the Cape of Good Hope, Cape Cormorin, the ſouthern extremity of New Holland, and that of Patagonia; Foſter's Obſervations, p. 11. 12.

To theſe geological proofs perhaps I may be permitted to add the tradition of the orthodox Hindus, that the globe was divided into two hemiſpheres, and that the ſouthern was the habitation of dæmons that warred upon the Gods. 3 Aſiatic Reſearches, 51& 52. This war is commonly thought to be an allegorical deſcription of the *flood*, and hence the olive branch, denoting a diminution of the flood, became a ſymbol of peace.

Did not Noah reſide on the borders of the ſouthern ocean, otherwiſe he could not ſee that the great abyſs was opened? and did not an inundation from the ſouth-eaſt drive the ark north-weſt to the mountains of Armenia? Theſe conjectures are at leaſt conſiſtent with the moſt probable notions of the primitive habitation of man, which I take to be near the ſources of the Ganges (as Joſephus expreſſly mentions) the Bourampooter and the Indus, from which, as the temperature grew colder, mankind deſcended to the plains of India.

This unparalleled revolution Moſes informs us was introduced by a continual rain for forty days. By this the ſurface of the earth muſt have been looſened to a conſiderable depth; its effects may even have been in many in many inſtances deſtructive; thus in Auguſt 1740 ſeveral eminences were ſwept away, nay the whole mountain of Lidſheare, in the province of Wermeland in Sweden, was rent aſunder hy a heavy fall of rain for only one night. 27 Schwed. Abhand, 93. This looſening and opening of the earth was in many places where the marine inundation ſtagnated an uſeful operation to the ſoil ſubſequently to be formed, as by theſe means ſhells and other marine exuviæ were introduced into it which rendered it more fertile. By this rain alſo the ſalt water was diluted, and its pernicious effects both to ſoil and freſh water fiſh in great meaſure prevented. The deſtruction of animals ſerved the ſame purpoſes, and might, in many inſtances, be neceſſary to fertilize a ſoil produced by the decompoſition of primary mountains; from the animals thus deſtroyed the phoſphoric acid ſound in many ores may have originated.

But the completion of this cataſtrophe was undoubtedly effected, as Moſes alſo ſtates, by the invaſion of the waters of the great abyſs, moſt probably, as I have ſaid, that immenſe tract of ocean ſtretching from the Philipine iſlands or rather from the Indian continent on the one ſide to terra-firma on the other, and thence to the ſouthern pole, and again from Buenyos Ayres to New Holland, and thence to the pole.—Tracing its courſe on the eaſtern part of the globe, we ſhall ſee it impelled northwards with reſiſtleſs impetuoſity againſt the continent which at that time probably united Aſia and America. This appears to have been torn up and ſwept away (except the iſlands that ſtill remain) as far north as latitude 40°; its further progreſs appears to have been ſomewhat checked by the lofty mountains of China and Tartary, and thoſe on the oppoſite American coaſt; here then it began to dilate itſelf over the collateral countries; the part checked by the Tartarian mountains forming, by ſweeping away the ſoil the deſart of Coby, while the interior or middle torrent preſſed forward to the pole, but the interior ſurge being ſtill more reſtricted by the contiguous, numerous and elevated mountains of eaſtern Siberia and America, muſt at laſt have ariſen to a height and preſſure which over-bore all reſiſtance, daſhing to pieces the heads of thoſe mountains, as Patrin and Steller remark, and bearing over them the vegetable and animal ſpoils of the more ſouthern, ravaged or torn up continents, to the far extended and inclined plains of weſtern Siberia, where its free expanſion allowed it to depoſit them. Hence the origin of the bones and tuſks of elephants and rhinoceri found in the plains, or inconſiderable ſandy or marly eminences in the north weſtern parts of Siberia, as Mr. Pallas rightly judges.

If now, returning to the ſouth, we contemplate the effects of this overwhelming invaſion on the more ſouthern regions of India and Arabia, we ſhall, where the coaſts were undefended by mountains, diſcover it excavating the gulfs of Nanquin, Tonquin and Siam, the vaſt Bay of Bengal and the Aarabic and Red Seas. That the ſouthern capes, promontories and headlands, were extenuated to their preſent ſhape by the deluge, and not by tides or the currents ſtill obſerved in thoſe ſeas, may be inferred from the inefficacy of thoſe feebler powers to produce any change in them for many paſt centuries.

The chief force of the inundation ſeems to have been directed northwards in the meridians of from 110 to 200 eaſt of London. In the more weſtern tracts it appears to have been weaker; the plains of India I ſuſpect to have been leſs ravaged, or perhaps their ſubſequent fertility may have been occaſioned by the many rivers by which that happy country is watered. Not ſo thoſe of Arabia; their ſolid baſis, reſiſting the inundation, was obliged to yield its looſer ſurface, and remains even now a ſandy deſart, while the interior more mountainous tracts, intercepting, and thus collecting, the waſhed off ſoil, are, to this day, celebrated for their fertility, 2 Niebuhr, 45 and 320. Iriſh edition. To a ſimilar tranſportation of the antient vegetable ſoil, the vaſt ſandy deſarts of Africa, and the barrenneſs of moſt of the plains of Perſia, may be attributed.

The progreſs of the Siberian inundation once more claims our attention; that it muſt have been here for ſome time ſtationary may be inferred from its confinement between the Altaiſchan elevation on the ſouth, and the Ouralian mountains on the weſt, and the circumpolar mountains on the ſide of Greenland. Hence the excavations obſerved on the northern parts of the former, and the abrupt declivities on the eaſtern flanks of the latter, while the weſtern diſcover none. New reinforcements from the ſouth-eaſt muſt at length have ſurmounted all obſtacles; but the ſubſequent ſurges could not have conveyed ſuch a quantity of ſhells or marine productions as the firſt, and hence, though many are found on the more northern *plains*, ſcarce any are found on the great Altaiſchan elevation.

The maſs of waters now collected and ſpread over the Artic regions, muſt have deſcended partly ſouthwards over the deſarts of Tartary, into countries with which we are too little acquainted to trace its ravages, but from the oppoſition it muſt have met in theſe mountainous tracts, and the repercuſſion of their craggy ſides, eddies muſt have been formed to which the Caſpian, Euxine and other lakes may have owed their origin. Part alſo muſt have extended itſelf over the vaſt tracts weſt of the Ourals, and there expanded more freely over the plains of Ruſſia and Poland down to latitude 52° where it muſt have met with and be oppoſed by the inundation originating in the weſtern parts of the Pacific ocean, this ſide the Cape of Good Hope, and thence impelled northwards and weſtwards in the ſame manner as the eaſtern inundation already deſcribed, but with much leſs force, and ſweeping the continents of South America (if then emerged) and of Africa conveying to Spain, Italy and France, and perhaps ſtill farther North, elephants and other animals and vegetables hitherto ſuppoſed partly of Indian and partly of American origin.

THAT the courſe here aſſigned is not imaginary appears from the ſhells, vegetables, and animal remains of thoſe remote climates, ſtill found in Europe, and from the diſcovery both of the European and the American promiſcuouſly mixed with each other at Fez. 1 Bergman Erde Kugel, 252. 249.

So alſo in Germany, Flanders and England, the ſpoils of the northern climates, and thoſe of the ſouthern alſo, are equally found; thus the teeth of arctic bears and bones of whales, as well as thoſe of animals of more ſouthern origin, have been diſcovered in thoſe parts.

THE effect of the encounter of ſuch enormous maſſes of water; ruſhing in oppoſite directions, muſt have been ſtupendous, it was ſuch as appears to have ſhaken and ſhattered ſome of the ſolid vaults that ſupported the ſubjacent ſtrata of the globe. To this concuſſion I aſcribe the formation of the bed of the Atlantic from latitude 20° ſouth up to the north pole. The bare inſpection of a map is ſufficient to ſhew that this vaſt ſpace was hollowed by the impreſſion of water; the protuberance from Cape Frio to the river of the Amazons, or La Plata in South America, correſponding with the incavation on the African ſide from the river of Congo to Cape Palmas; and the African protuberance from the Straits of Gibraltar to cape Palmas, anſwering to the immenſe cavity between New York and Cape St. Roque. The depreſſion of ſuch a vaſt tract of land cannot appear improbable when we conſider the ſhock it muſt have received, and the enormous load with which it was charged. Nor is ſuch depreſſion and abſorption unexampled ſince we have had frequent inſtances of mountains ſwallowed up, and ſome very lately in Calabria [*]

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[*] The Bay of Galway appears to have been originally a granitic mountain, ſhattered and ſwallowed during this cataſtrophe, for fragments of granite are found on its northern ſhore, though none in the neighbouring mountains, which are chiefly argillitic. Alſo a vaſt maſs of granite called the Gregory, lately ſtood on one of the iſles of Arran, 100 feet at leaſt above the level of the ſea, 10 or 12 feet high, as many broad, and about twenty in length. Though the whole maſs of the iſland conſiſts of compact limeſtone and no granitic hill within 8 or 10 miles of it. This was ſhattered by lightning in 1774.

The wreck of ſo conſiderable an integrant part of the globe muſt of neceſſity have convulſed the adjacent ſtill ſubſiſting continents previouſly connected with it, rent their ſtony ſtrata, burſt the ſtill more ſolid maſſes of their mountains, and thus in ſome caſes formed, and in others prepared, the inſular ſtate to which theſe fractured tracts were reduced; to this event therefore I think may be aſcribed the bold ſteep and abrupt weſtern coaſts of Ireland, Scotland and Norway, and the numerous iſles that border them, as well as many of thoſe of the Weſt Indies. The Britannic iſlands ſeem to have acquired their inſular ſtate at a later period, though it was probably prepared by this event; but the baſaltic maſſes on the Scotch and Iriſh coaſts and thoſe of Feroe appear to me to have been rent into pillars by this concuſſion.

During this elemental conflict, and the craſh and ruin of the ſubmerged continent, many of its component parts muſt have been reduced to atoms, and diſperſed through the ſwelling waves that uſurped its place. The more liquid bitumens muſt by the agitation have intimately mixed with them. They muſt alſo have abſorbed the fixed air contained in the bowels of the ſunk continent; and further, by this vaſt continental depreſſion, whoſe derelinquiſhed ſpace was occupied by water, the level of the whole diluvial ocean muſt have been ſunk; and the ſummits of the higheſt mountains muſt then have emerged. In this ſtate of things it is natural to ſuppoſe that if iron abounded in the ſubmerged continent, as it does at this day in the northern countries of Sweden, Norway and Lapland adjacent to it, its particles may have been kept in ſolution by the fixed air, and the argillaceous, ſiliceous and carbonaceous particles may have been long ſuſpended. Theſe muddy waters mixing with thoſe impregnated with bitumen, the following combinations muſt have taken place: 1°. If carbonic matter was alſo contained in the water, this uniting to the bitumen muſt have run into maſſes no longer ſuſpenſible in water, and formed ſtrata of coal. 2do. The calces of iron by the contact of bitumen were in great meaſure gradually reduced, and together with the argillaceous and ſiliceous precipitated on the ſummits of ſeveral of the mountains not yet emerged, and thus formed baſaltic maſſes, that during deſiccation ſplit into columns; in other places they covered the carbonaceous maſſes already depoſited, and by abſorbing much of their bitumen rendered them leſs inflammable, and hence the connexion which the ſagacious Werner obſerved between baſalts and coal. The fixed or oxygen air, erupting from many of them, formed thoſe cavities, which being filled by the ſubſequent infiltration of ſuch of their ingredients as were ſuperfluous to their baſaltic ſtate, formed calcedonies, zeolytes, olivins, baſaltines, ſpars, &c. Hence moſt of the mountains of Sweden that afford iron, afford alſo bitumen *. Hence alſo the aſphalt found with Trap † and under baſalts ‡, and in balls of calcedony found in Trap §.

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* Berg. Jour. 1789. p. 2005.

† Berolding on Mercury, p. 38 and 240.

‡ Von Salis 171. 3. Noſe. 146.

§ 10 Naturforſch. 43.

THIS I take to be the *laſt* ſcene of this dreadful cataſtrophe, and hence no ſhells are found in theſe baſalts, they having been previouſly depoſited, though ſome other lighter marine vegetable remains have ſometimes been found in them; ſome argillaceous or ſandſtone ſtrata may alſo have been depoſited at this period.

ON this account however of the formation of the baſalts which crown the ſummits of ſeveral lofty peaks, I lay no more ſtreſs than it can juſtly bear; I deliver it barely as an hypotheſis more plauſible than many others.

IT has been objected to the Moſaic account that the countries near Ararat are too cold to bear olive trees. Tournfort, who firſt made this objection, ſhould recollect, that at this early period the Caſpian and Euxine ſeas were joined, as he himſelf has well proved. This circumſtance ſurely fitted a country lying in the 38th degree of latitude to produce olives (which now grow in much higher latitudes) at preſent chilled only by its diſtance from the ſea.

A MORE plauſible objection ariſes from the difficulty of collecting and feeding all the various ſpecies of animals now known, ſome of which can exiſt only in the hotteſt, and others only in the coldeſt climates; it does not however appear to me neceſſary to ſuppoſe that any others were collected in the ark but thoſe moſt neceſſary for the uſe of man, and thoſe only of the graminivorous or granivorous claſſes, the others were moſt probably of ſubſequent creation. The univerſality of the expreſſions, Gen. chap. vi. ver. 19. " Of every living thing, of all fleſh, two of every ſort ſhalt thou " bring into the ark," ſeem to me to imply no more than the ſame general expreſſions do in Gen. chap. i. ver. 30. " And to *every* " beaſt of the earth, and to *every* fowl of the air, have I given " *every* green herb for meat;" where it is certain that only graminivorous animals are meant. At this early period ravenous animals were not only not neceſſary but would have been even deſtructive to thoſe who had juſt obtained exiſtence, and probably not in great numbers. They only became neceſſary when the graminivorous had multiplied to ſo great a degree that their carcaſſes would have ſpread infection. Hence they appear to me to have been of poſterior creation; and to this alſo I attribute the exiſtence of thoſe that are peculiar to America and the torrid and frigid zones.

THE atmoſphere itſelf muſt have been exceedingly altered by the conſequences of the flood. Soon after the creation of vegetables, and in proportion as they grew and multiplied, vaſt quantities of oxygen muſt have been thrown off by them into the then exiſting atmoſphere without any proportional counteracting diminution from the reſpiration or putrifaction of animals, as theſe were created only in pairs, and multiplied more ſlowly; hence it muſt have been much purer than at preſent; and to this circumſtance perhaps the longevity of the antediluvians may in great meaſure be attributed. After the flood the ſtate of things was perfectly reverſed, the ſurface of the earth was covered with dead and putrifying land animals and fiſh, which copiouſly abſorbed the oxygenous part of the atmoſphere and ſupplied only mephitic and fixed air; thus the atmoſphere was probably brought to its actual ſtate, containing little more than one-fourth of pure air and nearly three-fourths of mephitic. Hence the conſtitution of men muſt have been weakened and the lives of their enfeebled poſterity gradually reduced to their preſent ſtandard. To avoid theſe exhalations it is probable that the human race continued for a long time to inhabit the more elevated mountainous tracts. Domeſtic diſturbances in Noah's family, briefly mentioned in holy writ, probably induced him to move with ſuch of his deſcendants as were moſt attached to him to the regions he inhabited before the flood, in the vicinity of China, and hence the early origin of the Chineſe monarchy.

THIRD ESSAY.

OF SUBSEQUENT CATASTROPHES.

A Shock ſo violent and univerſal as that which pervaded the globe during the diluvian revolution muſt have produced not only innumerable alterations in the whole extent of its ſurface endleſs to detail (and belonging rather to the natural hiſtory of its particular geographic diviſions than to a general ſurvey of the whole) but alſo have prepared, by looſening its baſis, many other changes that took effect ſome centuries after, as I have already hinted; of theſe however ſome are ſo important by their connexion either with the paſt tranſactions of the inhabitants of the globe, or with the actual external appearance or ſubterraneous ſtate of the countries with which we are beſt acquainted, that they cannot be totally paſſed over in ſilence; ſuch are the total ſeparation of Aſia from America, the coarctation of the Baltic, the ſeparation of the Caſpian from the Black Sea, and the junction of this with the Mediterranean and of the Mediterranean with the Ocean, and laſtly, the ſeparation of Ireland from Britain and of Britain from the Continent.

THESE events are either totally omitted by hiſtorians, or only ſlightly mentioned by that hiſtory, from its mixed nature ſtiled *fabulous;* in ſuch caſes imagination has commonly taken up the pen of the hiſtorian, but poſſeſſing neither the inclination nor the talents neceſſary for converting natural hiſtory into *romance*, the account I ſhall give of them muſt be very ſhort, and ſuch as is ſuggeſted by the moſt probable traditions or actual appearances.

1°. OF the ſeparation of Aſia from America we have no traditional account; it is certain however that they were once joined, as the inhabitants of the former paſſed into the latter; they ſtill approach each other very nearly in the northern parts, and the intermediate ſpace is filled with iſlands. The junction immediately after the flood I ſtated in my former Eſſay to have reached ſo low as latitude 40°, becauſe I find America peopled by nations of different characters, degrees of civilization and languages; ſuch varieties could ſcarcely occur among a people inhabiting the ſame climate and formed to the ſame habits. As Cain was originally baniſhed from his brethren, ſo I imagine malefactors anciently were into the colder deſerted climates by their civilized brethren in Aſia, and thus the Eſquimaux originated that are equally found in both continents and other ſavages; and hence the prædatory diſpoſition of the Scythian tribes. That the poſtdiluvian junction did not reach lower than latitude 40° I infer from the abſence of elephants from the warmer regions of America.

THE utter ſeparation of both continents was moſt probably the effect of excavations by volcanos; at leaſt this cauſe is adequate to ſuch an effect, and it ſtill exiſts in the moſt northern parts. The ſuperior fertility of the weſtern coaſt of America may ariſe from the lavas ejected on that coaſt.

2d. THAT the Baltic in all its branches was anciently much more extended than at preſent many reaſons induce us to believe;

lieve; but principally the ſtate in which we at preſent find the immenſe plains of Southern Ruſſia from Peterſburgh to Pultowa.

THESE plains for ſome hundred miles to the ſouth of Peterſburgh are ſtill a moraſs, and farther ſouthwards they are covered with ſand, pebbles and petrified ſhells*. This water is not indeed ſalt, but neither was the Baltic ſo originally, and is but ſlightly ſo at preſent, for it ſeems to have been formed by the confluence of the various rivers that flow into it, which at laſt burſt a paſſage into the German ſea, by communication with this it became ſalt. At preſent there are three paſſages by which they communicate, at firſt probably but one; to the opening of the two laſt the reduction of this ſea to its preſent limits is owing.

3d. THE ancient communication between the Caſpian, the Lake of Aral and the Black Sea, before the opening of the Thracian Boſphorus, which enabled theſe ſeas to diſcharge themſelves into the Mediterranean, is rendered highly probable if not demonſtrated by Pallas, 3 Pallas Reiſe 368. He obſerved that between the rivers Sarpa and Volga, from Zarzycin down to the Caſpian ſea, the land ſlopes with conſiderable indentures and abrupt promontories as if it had been an ancient coaſt, and continues on the ſame level on the eaſt of the Wolga in the ſandy deſert of Narym and in the more ſouthern ſteppes or deſerts betwen the Wolga and the Jaick or Ural. The ſhells which abound in this extenſive *flat* exactly reſemble thoſe of the Caſpian and are different from thoſe of the adjacent rivers; theſe deſerts are moreover covered with ſand, contain abundance of ſalt and ſalt lakes, and produce only ſuch vegetables as grow on ſalt marſhes; whereas the upland that borders this flat contains a genuine black fertile ſoil, and no ſhells reſembling thoſe of the Caſpian, but only thoſe of ancient date, ſuch as thoſe found in other countries, and of the ſorts called *Pelagicæ* that belong to the deepeſt ſeas. Hence he collects that the level of the Caſpian before it was reduced to its preſent limits was ninety feet higher than at preſent; thus it was enabled to communicate with the Euxine by the ſea of Aſoph. In this ſtate it muſt have remained from the period of the deluge until about 1800 years before our Æra, the moſt probable date of the ſeparation of theſe ſeas, as Mr. Foſter has ſhewn in a learned memoir in the Gottingen Magaz. 1780, p. 140.

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* Schwed. Abhand. 1773, 181, &c. 2 Bergm. Erde kugel. 215.

Buffon pretends the rupture of the iſthmus that ſeparated this ſea from the Mediterranean preceded the deluge mentioned by Moſes, merely it ſhould ſeem to contradict that moſt authentic hiſtorian, for he aſſigns no reaſon independent of his own hypotheſis and is deſtitute of the ſupport even of the moſt fabulous tradition. 1, Epoques, 8vo. p. 291.

The rupture of the iſthmus was probably ſudden and total, and conſequently effected by an earthquake. To diſcover its effects, we muſt firſt conſider the antecedent ſtate of the Mediterranean:

The Mediterranean, before its union with the Black Sea and the Ocean, was moſt probably a baſon much narrower and ſhallower than at preſent; for though it received ſeveral conſiderable rivers, the Nile, the Rhone and the Po, yet ſince even now evaporation from its ſurface is ſufficient to prevent it from overflowing, notwithſtanding that the Ocean on the one ſide and the Euxine on the other flow into it, we may well ſuppoſe that when it communicated with neither, evaporation kept its level much lower; when therefore by the rupture of the Thracian Iſthmus on the one ſide, and of the African which joined Ceuta with Gibraltar on the other, the waters of both were poured in upon it, an immenſe preſſure took place on its bed, under which it ſunk and fell into the inferior cavity of the globe; during this tremendous tumult the iſlands of Sicily, Sardinia, Corſica and thoſe of the Archipelago were torn off, and Italy was lengthened to its preſent ſhape. The neighbouring ſhores of France and Spain, and more eſpecially thoſe of Africa as being much lower, and thoſe of Greece and Aſia, muſt have been inundated to a great extent, and hence the ſaline ſubſtances ſtill exiſting in the adjacent parts of Africa, &c.

As the ſouthern parts of Italy ſtill abound in ſulphur and other inflammable ſubſtances, ſo probably did the contiguous parts of the bed of the Mediterranean, and by the immenſe friction which they muſt have ſuffered during this fall and the hollows that interceded the abrupted maſſes the firſt ſubterraneous fires might have been kindled and the beds of the actual volcanos prepared, which however did not probably acquire ſufficient ſtrength to burſt through the incumbent earthy ſtrata until ſome ages after, as I conjecture from the ſilence of Homer with reſpect to Etna, whoſe wonders had they exiſted in his time he probably would not have overlooked.

The ſeparation of Sicily from Italy is vouched by ancient traditions, as may be ſeen in Pliny, Ovid and Claudian.

Zancle quoque juncta fuiſſe
Dicitur Italiæ, donec confinia pontus
Abſtulit, & media tellurem reppulit unda. *Ovid Metam.*
Lib. 15. *v.* 290.
Trinacria quondam
Italiæ pars una fuit, ſed pontus & œſtus

Mutavere ſitum, rupit confinia Nereus
Victor, & abſciſſo interluit æquore montes. *Claudian. De Rapt. Proſerp. Lib.* 1.

THE ſteep abrupt coaſts from Genoa to Leghorn, deſcribed by Ferber in his twenty-ſecond letter, muſt be aſcribed to the rupture of the ſtrata, as tides, ſcarcely ſenſible in this ſea, cannot be even ſuſpected of having acted ſo powerfully upon them. The rapidity of the Rhone and of moſt of the rivers that fall into this ſea on the European ſide alſo indicate the great inclination of the ſtrata of the interior countries towards it, a natural conſequence of the depreſſion of their primitive ſupport. The mountains of Swiſſerland diſcover alſo veſtages of a ſhock on the ſouth eaſt, as I have already noticed, the detail of which I leave to the many excellent geologiſts of that country.

THE communication of the Euxine with the Ocean by means of the Mediterranean being thus formed, its level gradually ſubſided, the canal which joined it with the Caſpian dried up; as few great rivers fall into this (only the Wolga and the Ural) it was ſoon reduced by evaporation to its preſent level, which is ſaid to be lower than that of any other ſea, and thus the ſalt deſerts that border it, were formed, and its ſeparation from the Aral effected.

5° The entire ſeparation of Great Britain from the Continent muſt have happened long after the deluge, and that of Ireland from Great Britain at a ſtill later period; for wolves and bears were anciently found in both, and theſe muſt have paſſed from the Continent into Britain and from this into Ireland, as their importation cannot be ſuſpected. Theſe events as I already ſaid muſt have been prepared and have commenced by the ſhock communicated during the rupture and depreſſion of the bed of the Atlantic. The divulſive force that ſeparated Britain from Germany ſeems to have been directed from north to ſouth, but gradually weakened in its progreſs, Hence that iſland is ſharpened to the northwards, but the impreſſion muſt have been conſiderably weakened by the oppoſition of the granitic mountains that form the Shetland and Orkney Iſles. The looſer ſtructure of the calcareous or argillaceous and arenaceous materials of the more ſouthern parts offered leſs reſiſtance, was more eaſily preyed upon, and gave way to what is now called the German ocean, while theſe materials themſelves were ſpread over Weſtphalia, &c. or formed the ſubſoil of Flanders, Holland and the ſand-banks on its coaſt. The rupture of the iſthmus that joined Calais and Dover was probably effected by an earthquake at a later period, and gradually widened by tides and currents. Ireland was protected by Scotland from the violence of the northern ſhock, hence its ſeparation from Scotland appears to have been late and gradual. That from England was probably diluvial and effected by a ſouthern ſhock.

All theſe changes happened at leaſt three thouſand ſix hundred years ago, and I ſee no reaſon to think that the general level of the ocean has ſince been altered, but that of the continents ſeems to have varied conſiderably, being in ſome places higher and in others lower than anciently.

The depreſſion of continents originates from two cauſes, the firſt is the diminution of the waters that anciently pervaded them; the ſecond is the ſliding away of the inferior argillaceous ſtrata; to ſay nothing of cauſes merely contingent, as earthquakes and inundations.

After the deluge, the earth on which it reſted 150 days, and from which it very ſlowly retired, muſt have been drenched with water; vegetation quickly enſued, and twenty centuries ago moſt countries are known to have been covered with trees, and many until a much later period; in theſe circumſtances an infinity of ſmall rivulets muſt have been formed, which poured their ſtreams into the great rivers ariſing from their confluence; while the ſurface of the earth was protected by foreſts from the immediate influence of the ſun, the moiſture repleniſhing its interior muſt have remained. Again, as we ſee the craggy ſummits of many of the higheſt mountains, now decompoſing, being corroded by air and moiſture, we muſt ſuppoſe that the ſame cauſes have operated in the moſt ancient times, and that previous to their action theſe ſummits were much higher, and conſequently better fitted for collecting vapours than at preſent, but in modern times, from the extenſion of agriculture to countries where it never before was introduced, and the increaſing multiplication of mankind, the foreſts have in great meaſure diſappeared; the earth laid bare yields its waters to evaporation; the mountains lowered, no longer collect or condenſe the ſame quantity of vapour, the rivulets ceaſe, or are reduced to rills, and the earth freed from its pervading moiſture has naturally ſunk to a lower level. Hence moſt rivers were anciently much more conſiderable than at preſent, as we may ſee by the wide extended vales through which they run, the monuments of their ancient magnitude. Not only bogs have in ſome inſtances been known to ſlide over lower adjacent plains, but even portions of land ſeemingly more ſolid. Thus in France near Meudon in 1787 a whole ſide of a hill covered with trees deſcended 50 feet upon and covered to the height of 70 feet a neighbouring plain; its deſcent laſted ſix years. 43 Roz. 19. It was occaſioned by laying bare a bed of clay which by imbibing rain was tumefied and looſened. In Bohemia alſo, ſo late as the year 1770, a great part of the mountain of Ziegenberg ſlid down 38 fathom to the Elbe with its trees ſtill ſtanding partly erect and partly inclined. This was aſcribed to the ſolution of its inferior ſtratum, an argillaceous ſandſtone, whoſe argillaceous part was carried off by rain to which it had incautiouſly been expoſed. Reuſs *Bohemia*, 55.

In ſome places the ſurface of the earth has been elevated by the particles carried down by rain from greater elevations, or the gradual diſintegration of the ſtony ſubſtances that covered them, or by various local and contingent events. Hence many remains of antiquity depoſited on the ancient ſurface are now found at conſiderable depths, particularly in countries long devaſted.

The effects of volcanos in altering the face of the globe ſeem to me much more circumſcribed than many late writers have aſſerted: few mountains, and thoſe eaſily diſtinguiſhable, owe their origin to them; neither Veſuvius nor Ætna were formed by them, as is evident by the maſs of Neptunian ſtones that compoſe them; their effuſions ſeldom reach to a great diſtance, none above 100 miles. Of ancient volcanos now extinct, few can be traced by undoubted characters or hiſtoric accounts. Sidonius Apollinaris, Lib. 7. Epiſt. 1. mentions one near Vienne in Dauphiné which burned about the year 469; but by his account it is not clear whether it was a volcano or a pſeudo volcano; I ſuſpect the latter.

Tacitus alſo, at the end of the 13th Book of his Annals, mentions a volcano, or rather pſeudo volcano, that ravaged the country of the Jutiones; this is ſaid by many to be that of the Ubians; if ſo it muſt have been in the neighbourhood of Cologn, where ſome pſeudo volcanic remains are traced.

ON no ſubject have philoſophers been leſs cautious of the deluſions of imagination than on this of volcanos: the aſtoniſhment excited by their awful phœnomena ſeems to have affected even the underſtanding of ſome of their ſpectators. The author of many celebrated treatiſes on volcanos, lately travelling into Scotland, exclaimed, at the ſight of every black ſtone he met with, that it was *lava*, as I was informed by one of his companions *; even the very excellent Sir William Hamilton has frequently been ſeduced from the ſimple path of obſervation to which notwithſtanding he profeſſed to adhere, into the mazes and errors of a baſeleſs ſyſtem †. In a letter to Sir John Pringle, May 1776, he tells us that "Wherever baſaltic pillars like thoſe of the Giant's Cauſeway in "Ireland are found there without doubt a volcano muſt have ex"iſted, for they are mere lava." At preſent however I believe none will pretend that the volcanic origin of theſe pillars is out of the reach of doubt. He tells us that Veſuvius and Ætna were formed by a ſeries of volcanic eruptions ‡, though there is no certain proof that the former was ſo formed, and it is demonſtrable that the latter exiſted as a mountain before it became a volcano. Padre Torre, who has given a good deſcription of Veſuvius, inſiſts that its primitive ſtamina, if I may ſo call them, are not volcanic, but that it ſhould rather be conſidered as an extenſion of the Appenines; the number

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* Mr. Macie, a gentleman of the moſt exact and extenſive mineralogical knowledge.

† Ouvres de Hamilton, p. 10.

‡ Ouvres de Hamilton, p. 11.

of Neptunian ſtones it throws up, as may be ſeen in Gioeni's Lithography of Veſuvius, confirms this opinion; that the calcareous ſtrata are covered to a great depth with lava cannot be doubted, but that the whole maſs of Veſuvius conſiſts of volcanic ejections has not been proved; it is ſaid that in ſinking a well near the ſea ſhore beds of lava, have been found at great depths, but how eaſily may have the mother ſtones of lava, hornblende and ſhiſtoſe hornblende be miſtaken for lava itſelf?

WITH reſpect to Ætna there can be no doubt. Dolomieu found immenſe heaps of ſea ſhells in its north-eaſt flanks at the height of near 2000 feet over the ſurface of the ſea. Hence he juſtly concludes that this volcano exiſted as a mountain before it was uncovered by the ſea; he adds that at the height of about 2400 feet there are regular ſtrata of grey clay filled with marine ſhells; theſe ſtrata muſt then have been depoſited while the mountain was a forming under the ſea; it contained alſo he ſays priſmatic lava, but the word *lava*, particularly with the addition *priſmatic*, can now impoſe on no one *.

HE farther affirms that in particular parts of this mountain, calcareous ſtrata exiſt under the lava.—So alſo Count Borch, in his Letters on Sicily and Malta, informs us that the original ſtone of which Ætna conſiſts is granite mixed with jaſper, neither of which ſurely are lava; he ſays that it abounds in *mines* of lead and copper, neither of which are ever found in lava, though their fragments may. This laſt mentioned geologiſt pretends that Ætna is at leaſt 8000 years old, which he infers from the beds of vegetable earth which he diſcovered betwixt different beds of lava. Yet Dolomieu expreſly tells us that ſuch earth does not exiſt between beds of lava, *Ponces*, 472. and thus deſtroys the foundation of thoſe calculations that aſcribe to the globe an antiquity incompatible with the Moſaic hiſtory. Even if vegetable earth were found betwixt beds of lava, yet no concluſion relative to their age could fairly be deduced from that circumſtance, as ſome lava become fertile much ſooner than others. Thus Chevalier Gioanni in 1787 found lavas projected in 1766 in a ſtate of vegetation, while other lavas much more ancient ſtill remained barren. Dolom. *Ponces* 493. And in particular, it is well known that beds of volcanic aſhes and pumice vegetate ſooner than any other *.

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* Ponces, 465. 466. &c.

I HAVE been led into this detail by obſerving how fatal the ſuſpicion of the high antiquity of the globe has been to the credit of the Moſaic hiſtory, and conſequently to religion and morality; a ſuſpicion grounded on no other foundation than that whoſe weakneſs I have here expoſed. M. Dolomieu tells us that Canon Recupero denied having ever expreſſed any doubt on that head,

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* Ferber Italy, 169.

and could not conceive why a late celebrated traveller ſhould endeavour to render ſuſpicious the orthodoxy of his belief. So far from having been perſecuted on that account, he had a penſion from the court of Naples to his death, with many teſtimonies of eſteem and regard. *Ponces*, 471.